Space Weather Technical Forecast

Issued on Saturday, 27 January 2024 at 13:08 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1 Minor Storms day 4 (30 Jan) from onset of CH94 fast winds. Chance of isolated M-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare C2.9, occurring at 27/1039 UTC from AR3561 just over the southwest limb, which has been the most active region. There are three named regions on the disc, although AR3555 is also rotating over the western limb. AR3559 is a longitudinally wide region on the northwest-disc, but has been simplifying and has remained stable despite some magnetic complexity. The most notable growth has been in AR3560 in the southwest, which consists of three spots with penumbra but maintains a simple bipolar magnetic structure. Any other spots are small and simple.

No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Solar winds have been inconclusive for any notable arrivals, but have seen very weak speed increases, most notably at 26/1955 UTC. These could have been due to very weak and glancing CMEs, with observed speeds by ACE and DSCOVR rising from background, below 400 km/s, to be slightly elevated at 450-500km/s for a time before declining again. Density, however, remained at or below average. Interplanetary magnetic field (IMF), Bt, was generally weak, 5-8 nT. The north-south component Bz remained weak, between +7nT and -7nT. Phi angle was mostly negative (towards the Sun) at first, but has varied between positive and negative since around 26/2300 UTC. Geomagnetic activity was Quiet throughout (Kp 0-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background. GOES16 high energy (greater than 2MeV) electron flux was at background. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold on a steady trend. At 27/0000UTC the 24-hour integrated fluence observation was 1.11e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity expected, but with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: A couple of CMEs from 23-24 Jan that are expected to miss just ahead of Earth cannot be ruled out for giving further very slight enhancement early on day 1 (27 Jan). Otherwise winds are expected to be at background levels days 1-3 (27-29 Jan) before the onset of the next fast wind enhancement, from coronal hole 94. Slightly elevated winds are expected to develop, with the potential for a spell of increased geomagnetic activity during the onset. Ongoing chance of an Unsettled to Active spell at first day 1 (27 Jan) but easing to be mainly Quiet. Increasing again to Unsettled to Active with any fast wind onset, most likely day 4 (30 Jan), with a chance of G1 Minor Storm intervals.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background with only a slight chance of rising to in response to any notable flares from the sunspots nearing the west limb. High energy electron (greater than 2MeV) flux is expected to

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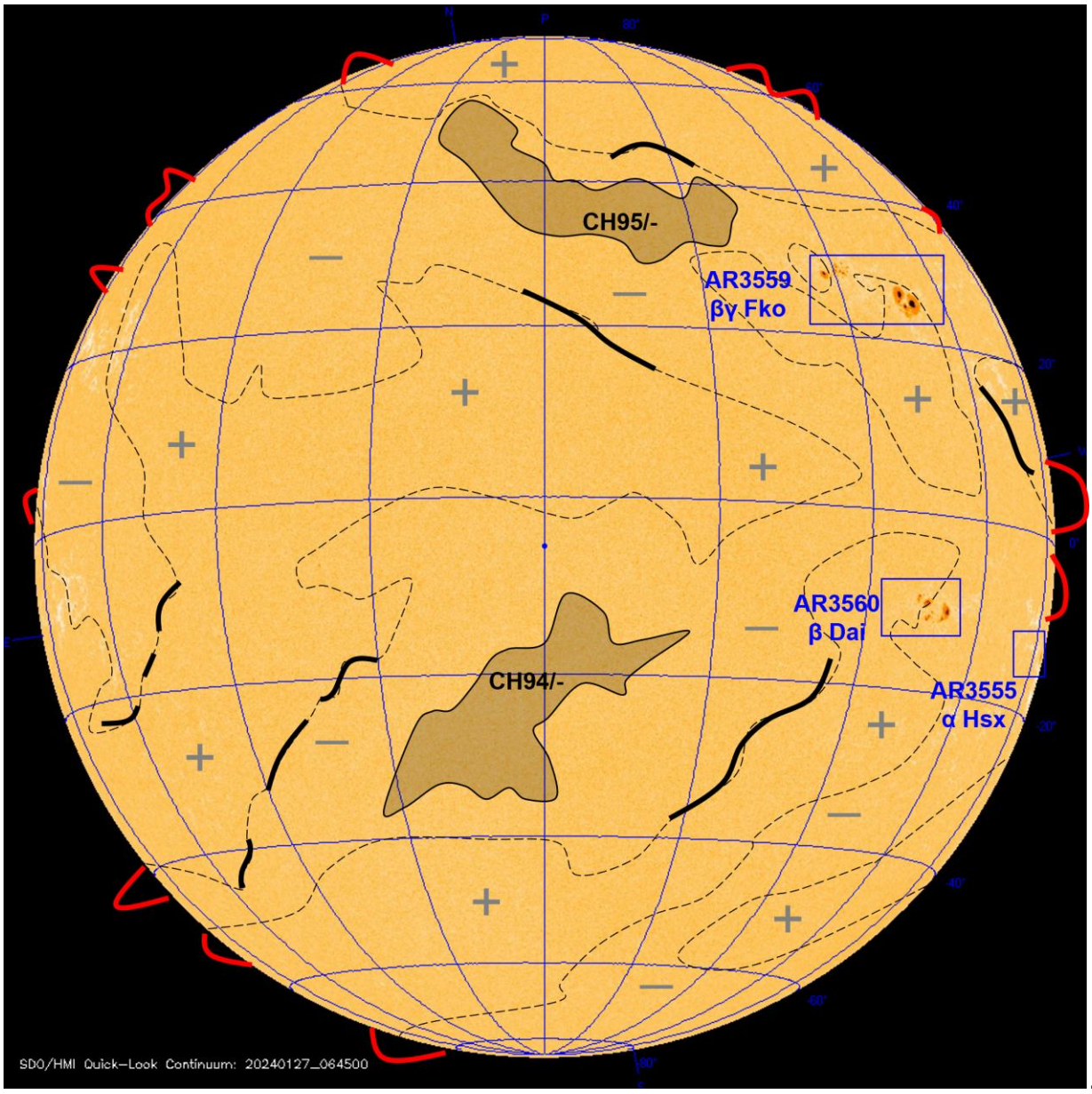
persist at mainly background until at least day 4 (30 Jan), when an increase is then possible due to the onset of any fast winds, but most likely beyond this forecast period. The associated electron fluence is forecast to remain well below the Active threshold.

Figure 1. Solar Analysis Valid 27/0645 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A couple of CMEs are expected to miss, passing ahead of Earth on day 1 (27 Jan), so further weak glances cannot be completely ruled out. These were primarily from the flare activity of AR3561 on 23-24 Jan.

Solar winds are at background and expected to remain at this level through days 1-3 (Jan 27-29) before the next enhancement from coronal hole 94/-. This is a persistent feature which produced limited enhancement on the last solar rotation, with only a weak enhancement currently indicated in enlil. Despite this, a stronger enhancement is considered likely on this rotation, most likely day 4 (30 Jan), with elevated winds expected.

This is due to the bulk of the hole being displaced further north, while Earth is now further south of the ecliptic. The Russell-McPherron effect also brings the potential for a slightly stronger connection to negative coronal holes at this time of year, although there is still some time until the March Equinox, when this effect is strongest. Along with the persistence of the coronal hole, this brings the greater potential for reasonable CIR region ahead of the fast wind onset, and subsequent geomagnetic activity. Coronal hole 95/- is likely too far north to influence conditions at Earth.

Any ongoing CME weak enhancement may bring Unsettled to Active intervals on day 1 (27 Jan) however mainly Quiet conditions are expected until either late day 3 or more likely day 4 (29-30 Jan). Any fast wind onset is then expected to bring Unsettled to Active geomagnetic activity with a chance of G1 Minor Storm intervals day 4 (30 Jan).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	5	40
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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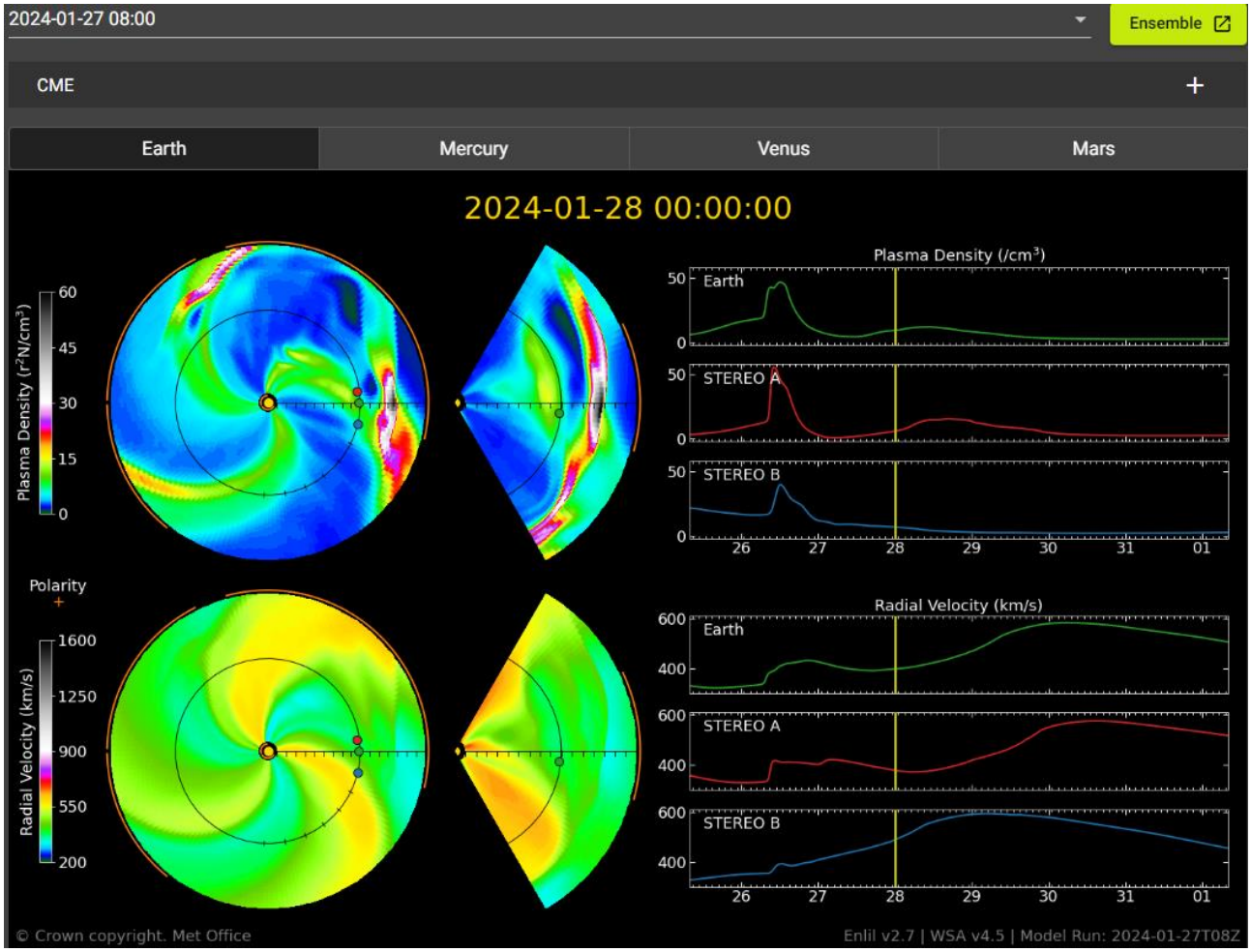
Figure 2: MOSWOC ENLIL showing weak CMEs ahead of Earth.



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Radio Blackouts - X-Ray Flares:

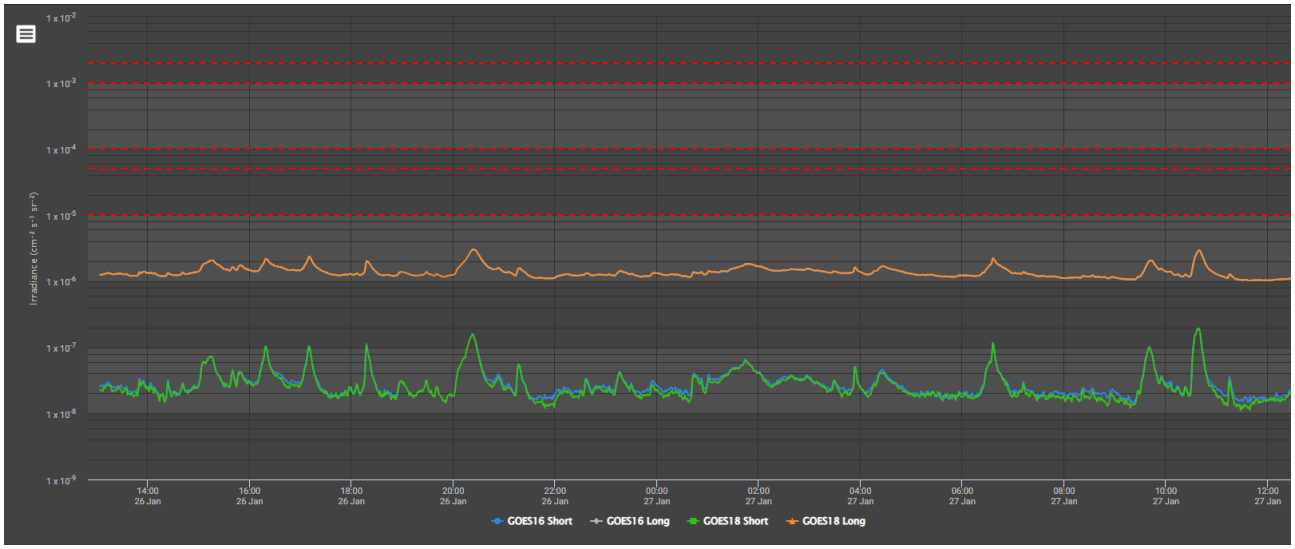
Low activity is likely to continue, but with a chance of isolated M-class flares.

The majority of recent activity has been from AR3561, which has now disappeared from view over the southwest limb. Despite this, the region has the potential to still be an observable flare source into day 2 (28 Jan). AR3559 in the northwest is a longitudinally wide region, but has continued a simplifying trend. While this maintains some complexity with the trailer region consisting of mixed polarities, the region has remained stable with no notable flaring since the M5 flare on 23 Jan.

The most notable growth has been in small region AR3560 in the southwest disc, with the growth and development of three small spots with maturing penumbra. This currently has a simple structure, but ongoing emergence to the south of the region suggests the potential for further growth and complexity to develop, and that this region is also a potential source for flare activity.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	40	30	30	30
Very Active	R3 to R5 X Class	No	2	2	1	1

Figure 3: GOES16/18 X-ray flux.



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Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux is at background. Despite AR3561 and AR3559 showing signs of weakening, there remains a slight chance of any notable flares increasing the observed flux at Earth, with a very slight and reducing chance of reaching the S1 Minor Radiation storm level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron (greater than 2MeV) flux as observed by GOES16 is currently at background, and any enhancement from any glancing CMEs day 1 (27 Jan) is not expected to be sufficient to bring more than a modest increase to brief Moderate levels. Furthermore, this is only a low chance with the CMEs expected to miss. The next notable enhancement will be from the onset of the fast winds of coronal hole 94, with the observed flux rising later day 4 (30 Jan), or more likely beyond this forecast period, once the initial solar wind pressure from the onset of the fast winds eases.

The associated 24 hour fluence is forecast to persist at background levels. This is supported by REFM which is currently providing good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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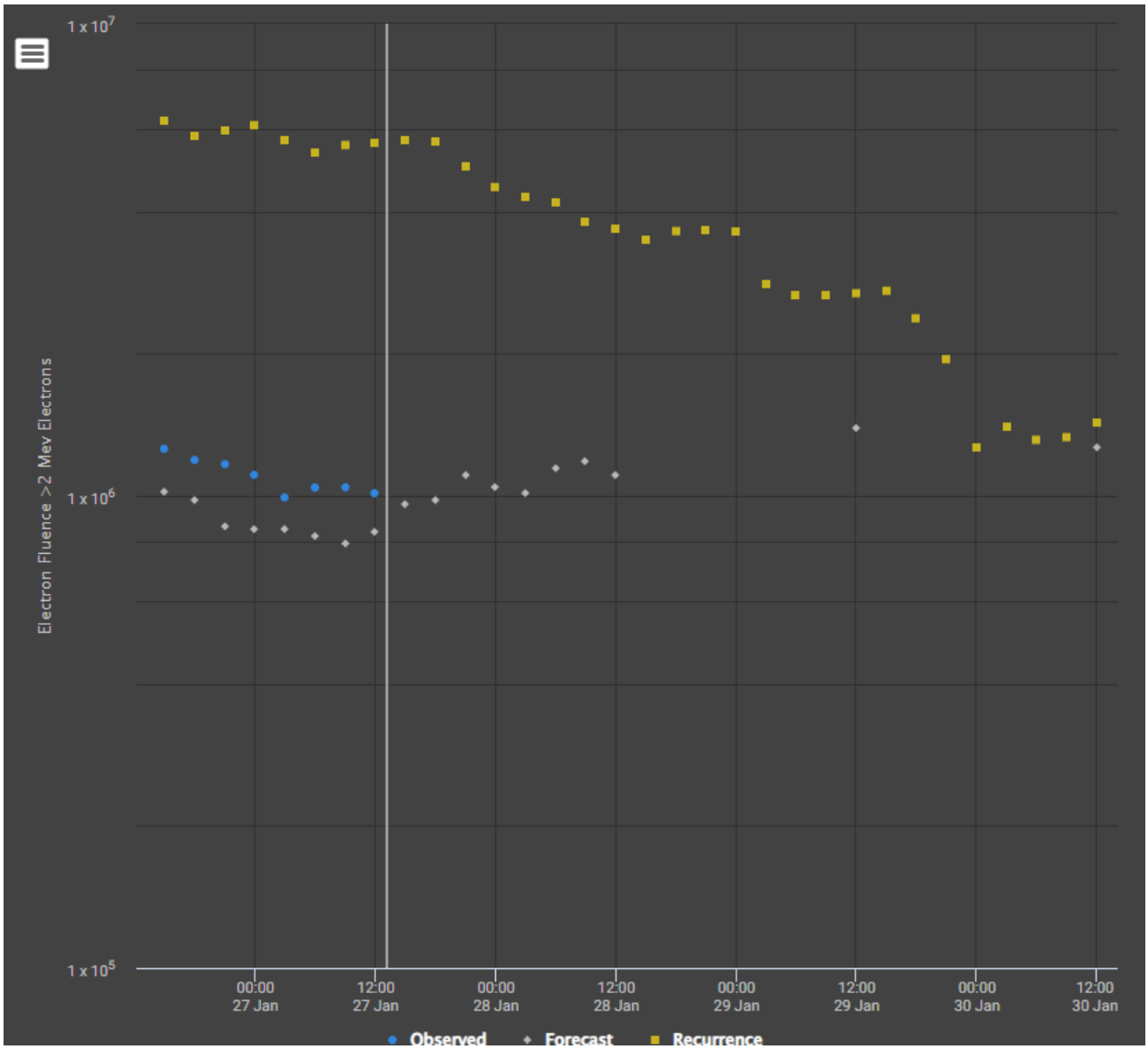
Figure 4: MOSWOC REFM.



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